DIVERSE POPULATIONS AND SUBSPECIES IN *ESCHATOCREPIS* (COLEOPTERA: DASYTIDAE)[1]

Charles D. Howell[2]

ABSTRACT: A detailed study of variation in many populations of *Eschatocrepis* throughout California reveals at least 13 different color and form morphs found in at least 12 different combinations in different populations. Male genitalia are believed to be identical, and most, if not all, morphs are sometimes found together in one population. Therefore they are believed to represent but one species, *Eschatocrepis constrictus.* This is an extremely polytypic species, in which the three previously named species are designated subspecies and a new subspecies, *E. c. riversidensis* is described.

A major problem confronting the systematist is the identification of intermediate forms from which he is tempted to name new species. This is particularly a problem in the Dasytidae, beetles common in more xeric regions of the western hemisphere, and also found in the old world. Collections are full of specimens which defy classification using existing keys. Added to the confusion is the fact that many species have been described from a single specimen. Casey (1895) named 41 species in the genus *Trichochrous,* each from one specimen.

To what extent a superfluity of species names exists is not precisely known, but needs serious attention. In my collections, some populations of Dasytidae are very variable, while others are quite uniform. *Eschatocrepis* is a genus in which variation has been reported, and is a good subject for study since only three species have been described in it. Blaisdell (1931) wrote of *Eschatopcrepis,* "the intra-specific variations have a moderately wide range."

I find this a modest statement, for in some parts of southern California the variation in populations of *Eschatocrepis* is so great as to baffle efforts to consign them to one of the described species. Such is the case on Mount Pisgah, near Yucaipa, San Bernardino County, California, where I have collected over five hundred specimens of Dasytidae in a dozen years. They include at least eight species in seven different genera. One fifth of the collections consists of *Eschatocrepis,* and is composed of at least ten different color morphs, including all of the named species.

The discovery of this extraordinary variation in so limited an area led to a series of questions to which this paper is addressed. Are all the populations of *Eschatocrepis* as variable as this one? Are the described species of the genus well-defined? Can geographical ranges be ascribed to any of the species or any of the morphs? Are any of them reproductively

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[2] The University of Redlands and the San Bernardino County Museum, Redlands, CA 92374

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isolated?

To obtain the precise information needed to answer these questions and to expand knowledge of systematists and collectors, a detailed study of the genus *Eschatocrepis* was undertaken.

The study is based on over 1500 specimens collected in California, with the exception of three specimens from Yuma, AZ, and two found in a collection at the University of California at Berkeley, CA and labelled "Jalapa, Mex." I have collected in all of the other contiguous western states without finding representatives of the genus. Likewise, Hatch (1962) does not record it in his studies of beetles of the Pacific northwest.

I have thoroughly examined Dasytidae collections from expeditions of the San Diego Museum to Baja California, and expeditions of entomologists of the University of California at Riverside throughout Mexico as far south as the State of Santa Cruz and have not found any *Eschatocrepis* among them. The Jalapa provenance is therefore questionable. My California collections range from sea level to over 6000 feet, from Solano and Marin counties southward, west and south of the Sierra Nevada Mountains to the Mexican border.

The Genus ***Eschatocrepis*** Le Conte

I recognize seven divisions of Dasytidae and place *Eschatocrepis* in the Dasytes Division along with *Daystes, Amphivectura, Enallonyx, Leptovectura, Dasytellus,* and *Hoppingiana.* Members of this division have a longitudinal ridge near the dorso-lateral borders of the pronotum, a feature variously described as "submarginal" after Casey (1895) in spite of its supramarginal position. They also possess ungual appendages, but with varying size combinations. *Eschatocrepis* (Blaisdell, 1938) has a pronotum with a transverse subapical constriction, like several of the genera, but is distinguished from the others by having ungual appendages that are slender, free from, and as long as the claws.

The body and elytra in my collections are black, except for two totally testaceous specimens, one found in the northern range, and one in the southern range, presumably the expression of a rare mutation,and not included in the study. I have not found a totally testaceous population.

Blaisdell (1931) recognized three species in the genus. *E. constrictus* Leconte (1852, *Dasytes*) is elongate, with cinereous pubescence, and testaceous legs, antennae and mouth parts. *E. nigripes* Blaisdell (1921) is also elongate and has brownish pubescence, and blackish legs, antennae and mouth parts. *E. desertus* Blaisdell (1931) is stouter, with pale pubescence and legs.

All the morphological features described by Blaisdell (1921 and 1931) were carefully studied. Two features he found useful for separating the species, antennal shape and characteristics of the fifth abdominal segment in males, I found too obscure to use. Therefore they are not discussed in this report.

Separating males from females can be done quite easily in most genera of Dasytidae on the basis of the structure of the fifth abdominal sternum. However, in *Eschatocrepis* I have found this feature unreliable. Males can be identified if they have reached a stage at which they rotate the curved aedeagus vertically causing the posterior segments of the abdomen to bend ventrally in a pronounced arch. This occurs before the organ is extruded. Otherwise sex may be uncertain, unless the genitalia are exposed. The shape and the large body of females are relative and not absolute criteria for separating them from males.

The characteristics selected for study are listed in the headings of Table 1. They are: body shape (elongate or less elongate), and colors of elytral pubescence, procoxae and legs.

The color of pubescence was recorded as either pale or brownish. Pale includes cinerous, whitish and luteous. Brownish ranges from ruddy brown to pale brownish or fuscous. Blaisdell missed this color in his first description of *E. nigripes* (1921) but corrected it later (1931). This is understandable because reflection from surfaces of curved hairs is often bright, obscuring a dark color. All specimens with a broad longitudinal area of brownish pubescence on each elytra were classified as brownish.

Procoxal colors are relatively easy to distinguish as black or pale (testaceous). There is a correlation between procoxal color and color of mouth parts, but it is more certain to identify procoxal color than to distinguish shades of colors of mouth parts.

Leg colors were first classified in five categories. The three paler categories (pale testaceous, testaceous, and ruddy testaceous) were finally combined into one, testaceous. (Test., Table 1). Two others were used: testaceous with dorsum of femora black, and black. This reduced the original ten color morphs to eight, but does not deny the existence of more variation than is shown in Table 2.

Body Shape

At the beginning of these studies, collections were separated on the basis of the apparent length-width (L/W) ratio, with elongate being defined as greater than 3.2, and less elongate as under 3.0. The discovery of populations with L/W ratios ambiguously between these extremes led to a detailed study of body shape. For this purpose the standard deviations of arithmetic means of body measurement were calculated for populations used as standards, and for those populations in which problems arose.

The results are shown in Table 2. Populations numbered 39-42, from the high desert, are clearly less elongate than the others, and represent Blaisdell's concept of *E. desertus.* The northern and southern populations are obviously more elongate, overlapping, but only in the extremes with the desert race.

Populations nos. 43 and 44 are small populations consistently between the defined extremes. They were collected on the high desert, but some distance from the other *desertus* populations to which they are regarded as belonging. This adds to the complexity of the genus and suggests hybridization between the more and less elongate forms.

In these calculations, usually, the apparent length was measured. Occasional specimens which were noticeably flexed were not measured. However, if a population contained many bent specimens a corrected length was calculated for the bent specimens by adding the length of the elytra to the combined lengths of the head and pronotum. Populations in which a corrected length was used are marked with an asterisk in Table 2. From the data in Table 2 it can be deduced that stouter specimens from an elongate population could not be distinguished from more elongate ones from the stouter populations.

Populations

In Table 1 the characteristics studied are tabulated for 44 populations of Eschatocrepis. "Population" designates a collection from a well-defined local area, sometimes based on only one collection, sometimes on several collections recorded over a period of many weeks or years. Those that appear to be similar are grouped consecutively. The morphs of the more elongate specimens are identified by the letters B, C, D, E, L, M, N and O, and the less elongate by G, H, I, J, P, R and S. The actual number of each morph in each population is indicated in the body of the table. These 14 morphs have

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Table 1. The number of each of 13 morphs found in 44 different populations or counties in California. An asterisk indicates collections tabulated by counties of the middle and northern range of the genus and not shown on the map, Fig. 2. Key to locations: 1. Junction, Wildwood Cyn. and Oak Glen Rds.; 2. Rock Creek Station; 3. L. Mathews; 4. L. Elsinore; 5. Strawberry Creek at 4000 feet elevation; 6. Menifee Valley; 7. Univ. of Calif., Campus hills, Riverside; 8. Pine Bench Rd., Oak Glen, elevation 5000 feet; 9. Whitewater Cyn; 10. Big Morongo Cyn.; 11. Devil's Cyn.; 12. Railroad Cyn.; 13. Palm Springs; 14. Moreno Valley, Perris; 15. Mt. Pisgah, Oak Glen, elevation 5000-5480 ft.; 16. Welk's Village; 17. Yaqui Pass; 18. L. Henshaw; 19. Deep Cyn. and its tributaries, Palm Desert; 20. San Timeteo Cyn.; 21. Fort Tejon; 22. Murietta; 23. Yorba Linda; 24. Millard Cyn.; 25. *Monterey Co.; 26. *San Luis Obispo Co.; 27. *Santa Barbara Co.; 28. Barton Flats; 29. Sunshine Ranch, Greenspot; 30. *Madera Co.; 31. *Stanislaus Co.; 32. *Santa Clara Co.; 33. *San Mateo Co.; 34. *Alameda Co.; 35. *San Joaquin Co.; 36. *Marin Co.; 37. *Contra Costa Co.; 38. Death Valley; 39. Kramer Junction; 40. Johannesburg; 41. Inyokern; 42. Trona; 43. Piute Cyn.-Kelso area; 44. Joshua Tree Natl. Mon.

ELONGATE VARIETIES OF *ESCHATOCREPIS*

Color: Elytra:	Pale pubescence				Brownish pubescence			
Pro-coxae:	PALE	DARK			PALE	DARK		
Legs:	Test.	Test.	Black Dorsm	Black	Test.	Test.	Black Dorsm	Black
MORPH	B	C	D	E	L	M	N	O
Pop.#								
1	13	0	0	0	0	0	0	0
2	23	1	0	0	0	0	0	0
3	7	0	0	0	0	0	0	0
4	15	0	0	0	0	0	0	0
5	15	0	0	0	0	0	1	1
6	26	0	0	0	0	0	0	0
7	40	0	0	0	6	0	0	0
8	4	0	1	1	0	0	0	0
9	0	23	6	1	0	3	0	0
10	0	11	0	1	0	2	0	0
11	0	11	4	0	0	0	0	0
12	8	4	17	1	0	0	0	0
13	0	5	25	0	0	0	5	0
14	14	2	0	0	0	7	4	0
15	41	2	6	9	3	18	13	4
16	0	9	0	0	0	14	0	0
17	1	5	0	0	0	6	0	0
18	0	11	0	0	0	20	0	0
19	12	136	0	0	0	110	4	0
20	1	0	2	0	0	0	9	0
21	0	0	9	3	0	0	5	2
22	0	0	7	0	0	0	13	3
23	0	2	12	1	0	1	12	2
24	1	4	8	2	0	9	7	2
25*	8	0	0	0	0	0	1	1
26*	2	1	4	0	0	0	3	8
27*	0	1	0	0	0	0	2	6
28	0	0	0	0	0	8	5	1
29	0	0	0	0	0	0	5	13
30*	0	0	0	0	0	0	0	10
31*	0	0	0	0	0	0	0	14
32*	0	0	0	0	0	0	4	54
33*	0	0	0	0	0	0	5	98
34*	0	0	0	0	0	0	1	10
35*	0	0	0	0	0	0	1	6
36*	0	0	0	0	0	0	13	73
37*	0	0	0	0	0	0	1	20

LESS ELONGATE VARIETIES

MORPH	G	H	I	J	P	Q	R	S
38	1	2	0	0	0	0	0	0
39	2	31	1	0	0	0	0	0
40	0	11	0	0	0	0	0	0
41	0	16	0	0	0	0	0	0
42	0	16	0	0	0	0	0	0
43	8	0	0	0	0	0	0	0
44	9	3	3	0	0	3	1	0

been found to occur in different combinations in different populations. Twelve different types of populations are singled out for discussion. They are illustrated in Fig. 1, showing graphically the frequencies of the morphs in each population. No specimens of morphs J and P were found.

Two of the named species stand out clearly in the graphs in Fig. 1. The H type population is *E. desertus,* and the 0 type is *E. nigripes.* The third species, *E. constrictus* does not stand out in a single graph. Leconte's type specimen came from San Diego County, probably from a CM type population, which is now common there (Figs. 1 and 2, nos. 16-19).

The collections from the northern range of the genus, nos. 30-37 in Table 1, all belong to population type 0 (Fig. 1). Fewer than ten percent of the specimens in these populations belonged to a paler morph, morph N. It is of interest that there is a complete absence of any of the other morphs in these populations, even though morphs L and M technically might, with their dark pubescence, be related to them. In addition to specimens listed in Table 1, additional specimens fitting type 0 populations were found in scattered collections in Napa, Solano, and San Benito counties. This is one of the largest collections of one type of *Eschatocrepis* in my possession.

The collections in the middle counties of the range of the genus are not so uniform (nos. 25-27 in Table 1). They represent scattered collections rather than populations, and are therefore not included in the population

Table 2. Body shape studies of a selected group of populations. In those populations indicated by an asterisk (*) the length of bent specimens was corrected for bending (see text).

Pop. no.	L/W Ratio	Average length (mm)	Average width (mm)	Range-length (mm)	Range-wideth (mm)
		High Desert Populations			
39	2.90±.13	2.46±.17	0.82±.05	2.12-2.86	0.77-0.90
40	2.89±.15	2.42±.22	0.82±.05	2.32-2.59	0.77-0.89
41	2.89±.11	2.37±.14	0.81±.04	2.26-2.63	0.77-0.89
42*	2.91±.15	2.49±.16	0.86±.06	2.29-2.70	0.75-0.93
43*	3.12±.15	2.73±.25	0.86±.08	2.42-3.11	0.79-1.02
44*	3.13±.05	2.62±.17	0.84±.05	2.32-2.90	0.73-0.93
		Southern Populations			
7	3.26±.09	2.54±.18	0.78±.04	2.13-2.92	0.68-0.87
2	3.17±.09	2.54±.14	0.80±.06	2.33-2.84	0.74-0.90
3	3.30±.10	2.54±.17	0.77±.06	2.30-2.90	0.68-0.89
13	3.23±.12	2.56±.16	0.79±.04	2.32-2.91	0.72-0.93
15*	3.32±.13	2.70±.23	0.82±.06	2.22-3.17	0.66-0.92
29*	3.22±.08	2.54±.21	0.79±.06	2.26-2.84	0.68-0.87
		Northern Populations			
31	3.33±.19	2.61±.17	0.78±.04	2.27-2.86	0.70-0.86
32	3.36±.13	2.94±.15	0.88±.05	2.58-3.09	0.78-0.94
36	3.32±.11	2.70±.20	0.81±.06	2.32-3.06	0.69-0.93
37	3.36±.18	2.82±.22	0.83±.05	2.46-3.22	0.76-0.91

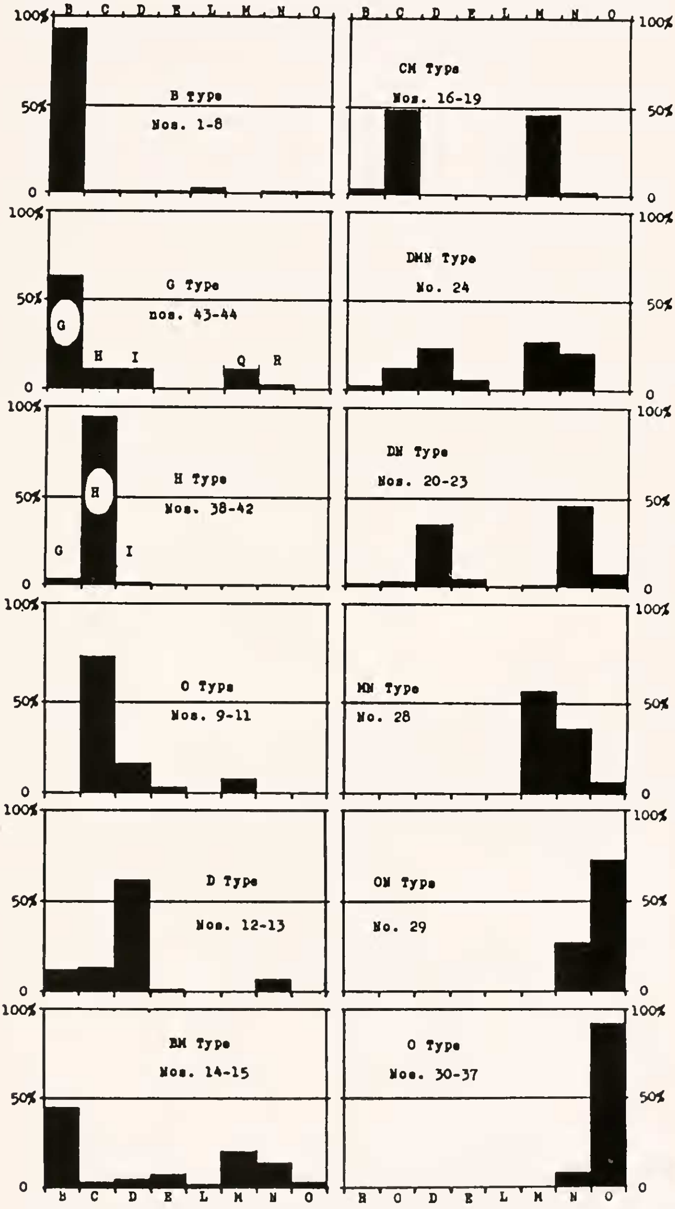

Fig. 1. Graphic representation of the data in Table 1, showing the percentages of each morph in each population type represented. In each graph, numerals indicate the numbers of populations in Table 1 from which the percentages were compiled. The letters on the horizontal coordinate indicate the morphs (G, H, I, Q and R are identical with B, C, D, M and N respectively, except for body shape).

study illustrated in Fig. 1. However, the record shows an occurrence of mixed pale and dark morphs, a situation that does not occur in the northern range, but suggests similarity to what we find discussed below, in the southern range.

The collections from southern California include the remaining twenty-two populations listed in Table 1. Although a typical 0 type population is not found here, all 13 morphs, and eleven of the twelve population types are found here (Fig. 1). The geograhical distribution of the eleven population types in southern California is shown on the map, Fig. 2. From this it can be seen that the population types are distributed randomly. What appear to be similar ecological situations within a few miles of each other may contain entirely different types of populations.

Two dark colored populations deserve special attention because of their similarity to the northern race. The ON population type (no. 29), while suggestive of *nigripes,* is by no means as uniform as the 0 type in northern

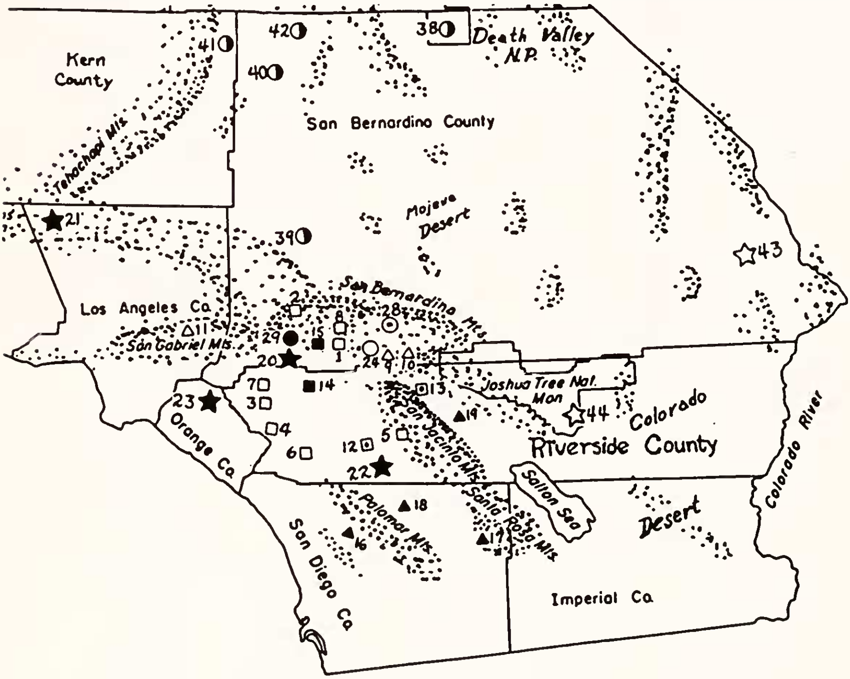

Fig. 2. Map of southern California showing the geographic locations of different population types of *Eschatocrepis constrictus* Lec. □ B type; △ C type; ▣ D type; ☆ G type (a typical *desertus*); ◑ H type (typical *desertus*); ■ BM type; ▲ CM type; ○ DMN type; ★ DN type; ◉ MN type; ● ON type. Typical O type (*nigripes*) has not been found in southern California.

counties. It was found at an elevation of 2,800 feet in chaparral on the south facing slope of the San Bernardino Mountains.

The second dark colored population (no. 28) was found at an elevation of 6,000 feet in the transition forest area of the San Bernardino Mountains. This is of interest because, if altitude and northern latitude have a similar effect on the selection of morphs, I would expect to find a typical 0 population at this altitude. However, no. 28 is an MN type, with very few 0 morphs. This fails to support a simple climatic explanation for the presence of the *nigripes* races in the north.

Populations of type B comprise the third largest group in my collection. Morph B may have been included in the minds of previous workers as part of the *E. constrictus* complex, but heretofore, populations of this type have not been recognized as existing. These populations are unique in that they recur in isolated pockets of over 90 percent B morphs (see Fig. 1). Among them are specimens with extremely pale legs which I, at first, designated as A morphs. Later, A morphs were included in the B designation, because they were never found separately from B morphs. The B type population is the extreme pale type, contrasting with all other types, and therefore deserves a subspecies status.

The population types, BM, C, CM, D, DMN, DN, G, MN and ON appear to be mixed or hybrid combinations with more internal variation than is found in O, H or B population types.

Male Genitalia

The occurrence of many, if not all morphs in one population, as in nos. 14 and 15, suggests that all morphs interbreed freely. Certain proof of this would require *in vitro* laboratory culture and breeding of specimens. This is impossible at the present, since developmental stages and their feeding habits are totally unknown. However, significant differences in male genitalia would indicate reproductive isolation. Therefore investigations of male genitalia were undertaken.

Since published figures of genitalia of Dasytidae do not exist, studies began with comparing genitalia of different genera, and then proceeded to studying differences between readily distinguishable species in the same genus. These studies revealed some intrageneric species are separable on the basis of genital morphology. Such differences were then sought between various morphs of *Eschatocrepis,* especially between morphs which are geographically or morphologically most extreme.

In Fig. 3 the variations in morphology of male genitalia of *Eschatocrepis* are illustrated. The greatest variation is in size, not in specific morphology. No unique structural feature was found differentiating one morph or population from another. It is concluded, therefore, that the genital morphology of males does not support reproductive isolation of any of the named species or morphs of *Eschatocrepis.*

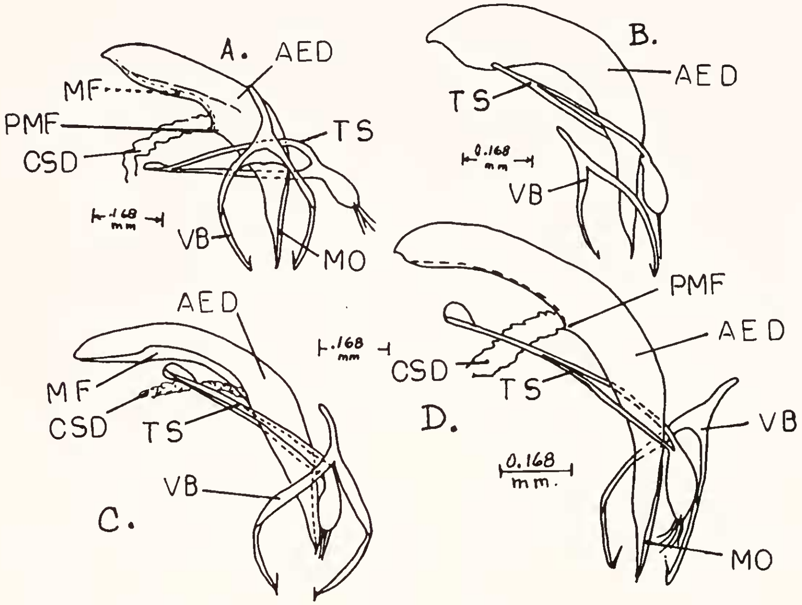

Fig. 3. Illustrations of the variation in male genitalia in *Eschatocrepis.* A-D represent extremes of appearance and of size. The largest are found in B morphs, the smallest in H morphs. The differences shown in the shape of the tube of the aedeagus occur in all populations. AED, aedeagus; CSD, common sperm duct; MF, median foramen; MO, median orifice; PMF, prominence of the median foramen; TS, tegminal strut; VB, ventral brace. A. H morph, from population no. 39; B. B morph from population No. 1; C. O morph from population no. 33; D. B morph from population no. 15.

CONCLUSION

The picture that emerges from this study is that of an extremely polytypic species, *Eschatocrepis constrictus* in California. It is far more varied than has been heretofore conceived, and includes many color and form morphs, of which thirteen are delineated in Table 1.

Populations differ from each other in their combinations of morphs and are often separated by only a few miles from different population types. It is believed that all populations are capable of breeding with each other, since many or all morphs are sometimes found in one population, and since male genitalia of different populations show no distinctive differences. The named species are therefore regarded as belonging to a single species. To affirm significant features of B type populations, which are very uniform in spite of being surrounded by differing populations, they are recognized as constituting a new subspecies.

Eschatocrepis constrictus riversidensis. New subspecies.

Elongate *Eschatocrepis* distinguished from all others by these pale features: cinereous pubescence, and testaceous (sometimes almost straw-colored) procoxae, legs, antennae and mouth parts. Populations of *Eschatocrepis* with from 90 to 100% of specimens fitting this description occur in Riverside and southern San Bernardino counties, CA, region D of the map, Fig. 4. Eight populations of this, the B type, are indicated in the map, Fig. 2. In addition, specimens fitting this description occur in lesser frequencies throughout region A, Fig. 4, in

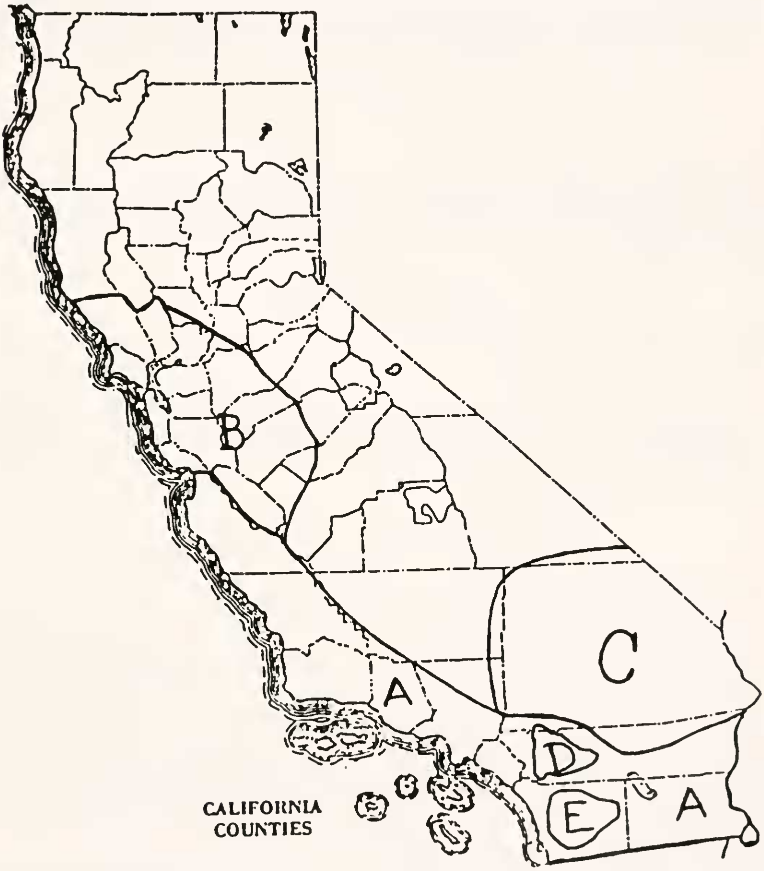

Fig. 4. Map of California showing the geographical distribution of the populations of *Eschatocrepis*. A - Variable population types; B - *E.c. nigripes;* C - *E.c. desertus;* D -location of *E.c. riversidensis* populations among other diverse populations; E - *E.c. constrictus.*

populations containing an abundance of darker morphs of *Eschatocrepis.*

Type collection made by F.A. Andrews, June 11, 1969, by malaise net set in the hills above the campus of the University of California at Riverside, CA. Numerous specimens have since been collected, especially from flowers of *Encelia* in the same area. The holotype, a male no. 1560, and an allotype no. 1567 are designated for the California Academy of Sciences in San Francisco. Over 150 paratypes from B type populations are in my possession, and many more B morphs from other populations, as can be seen from the data in Table 1.

Eschatocrepis constrictus constrictus **Lec. New designation.**

Eschatocrepis constrictus Leconte (1852).

Leconte's type species of the genus is recognized as a subspecies, typical of the major morphs found in CM population types of San Diego County. Other morphs may occur in this area, region E in Fig. 4, and C and M morphs in turn occur throughout region A of this map.

Eschatocrepis constrictus nigripes **Blaisdell. New designation.**

Eschatocrepis nigripes Blaisdell (1921).

This is a subspecies composed of O type populations in the northern range of the genus (region B, Fig. 4). These populations are composed exclusively of dark specimens. O morphs also occur scattered throughout region A, where rarely populations somewhat resembling O type populations also occur.

Eschatocrepis constrictus desertus **Blaisdell. New designation.**

Eschatocrepis desertus Blaisdell (1931).

This subspecies is recognized typically as composed of H morphs. A variant of it, a G type population, is recognized. The H type populations are more uniform than the G type. Both are less elongate and are found on the high desert regions of San Bernardino and Riverside counties, CA, region C in Fig. 4.

Mechanisms at Work and Future Prognosis

Much of the area in which the greatest diversity of these populations occurs is subject to brush fires. It is conceivable that a fire occurring during a sensitive phase of the life cycle could decimate a local population of Dasytidae. The population might then be reconstituted from a parentage lacking in some of the genetic variation of the original. No doubt in the past, as regenerating vegetation filled in the gaps, the exchange of genes could occur unhampered, and the original diversity would be restored. However, in recent years, burgeoning growth of freeways, housing developments, agriculture and industry, have caused a more permanent isolation of populations of insects, such as these which lack strong mobility.

The effect of this enforced isolation needs to be followed in the future. For this purpose, this study establishes a unique basis from which future changes in this variable species may be critically examined.

Genetic drift alone is not offered to explain the existence of uniform races in the north (O type populations) and certain areas of the high desert (H type populations). In these two instances it appears as if factors, not identified at the present, are exerting a selective influence. The evolution of these populations toward reproductive isolation is a possibility in the distant future.

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SOCIETY MEETING OF APRIL 17, 1985

The fifth regular meeting of the American Entomological Society was held on Wednesday evening, April 17, 1985 in the meeting room of the Academy of Natural Science in Philadelphia, PA.

The meeting was called to order by President Roger Fuester. After a brief report on the events of the Society's Council meeting by Recording Secretary Romig, Mr. Fuester asked for local notes of entomological interest. Gypsy moth egg masses were reported hatching in the Newark, DE area on April 15, 1985. Approximately 5-10% of the overwintering egg masses were seen to have hatched larvae by that date.

The guest speaker, Ms. Mitsie Toland of Malvern, PA was introduced by Dr. Joseph Sheldon. Ms. Toland's topic was, "Spreading the Good News About Insects." The talk presented a variety of ways to introduce entomologically naive people to inserts, and to eventually build people's comfort and interest levels about insects to a point where insects become as well understood and appreciated as other aspects of natural history. Ms. Toland's presentation was followed by a lively sharing of ideas and questions about how other members of the audience approach the teaching of entomology.

Ronald F. Romig,
Recording Secretary